



Private Line Emulation (PLE) enables Universal Packet Transport!

Traditionally, Communication Service Providers have maintained separate networks: one for IP and packet data traffic, and another for legacy services such as voice, E1/T1/T3 and SONET/SDH. Nowadays, almost all of the traffic carried on their networks is packet-based, including video, voice and data applications between data centers, mobile networks and end-user equipment. This requires operators to consolidate their traffic by transitioning their networks to all-packet, using IP routers, Ethernet switches and packet optical transport network elements. Such single network architectures streamline their operations and reduces both capital investments (CAPEX) and operational expenditures (OPEX).

However, network operators cannot ignore the vast installed base of equipment or wholesale carriers that offer legacy services to their customers. Circuit emulation is a proven and tested technology, used to transport legacy services across packet networks.

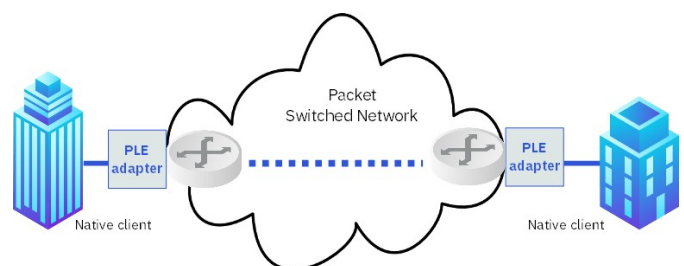
AimValley has a long history of offering several solutions for E1/T1/T3 and SONET/SDH, for instance using SAToP or CEP protocol in the company's line of Smart SFPs.

Currently a new method for transparent high bit-rate transport is being worked at and submitted to the Internet Engineering Task Force (IETF) through an internet-draft.

Erik van Veelen, one of our Senior Network Architects is contributing to forming this new Standard.

This new standardized methodology is named Private Line Emulation over Packet Switched Networks (PLE). Products supporting this standard enable network operators to reliably transport various types of high bit-rate client service such as SONET/SDH, Fibre Channel, OTN and layer 1 Ethernet bit-streams across packet networks.

All that is required are 2 PLE adapters at the service end-points that convert the client signal into packets and vice-versa.



PLE in Packet Switched Network

PLE utilizes established concepts for the transport of high bit-rate client signals across a packet network. It borrows the packetization and packet header encapsulation from SAToP, and mandates the use of Differential Clock Recovery to enable excellent reconstruction of client signals at the far-end to comply with the demanding jitter and wander requirements for SONET/SDH and other client signals.

High bit-rate signals at 25 Gb/s and above often use multiple signal lanes and forward error correction (FEC). These traffic streams need to be locally processed before transport. The PLE standard describes native service processing functions specific for each of the supported client signal types.

Why PLE?

- High Quality
- High Bit-Rate
- High-speed Interfaces
- Fully Transparent

"PLE enables the provision of new and valuable transport services on packet optical networks. This includes high bit-rate payloads such as OC192, FC64G, OTU4, and fully transparent Ethernet. These services can now be offered on packet networks with the same quality and availability as they were previously offered on separate wavelength networks or traditional TDM systems."

Erik van Veelen
Senior Network Architect

AimValley TDM to Packet Expertise

AimValley delivers design services and solutions based on FPGA IP cores, system and board designs and Smart SFPs to enable a smooth transition towards a unified packet network.

Development of high bit-rate PLE equipment requires an intimate understanding of Telecom network and equipment design, combined with knowledge of standards, protocols and interfaces. AimValley has a long history in the design and realization of carrier-class solutions for Tier 1 Network Equipment Manufacturers.

AimValley provides a wide range of expertise on high bit-rate Network Migration solutions:

- SONET/SDH, OTN, Ethernet and synchronization expertise, interpretation and knowledge of standards, such as ITU-T series, and IETF RFCs for circuit emulation
- Consultancy and architecture support on circuit emulation protocols, synchronization and network design
- Design and development at system level, as well as FPGA, PCB and testing, high-speed data interfaces considering signal integrity, PLL bandwidth and hold-over performance
- Customized hardware design including FPGA, PHY, high-speed Transceivers and PLL components
- Software and firmware designs for carrier-class and resilient solutions including network protection, clock recovery, fault and performance management.

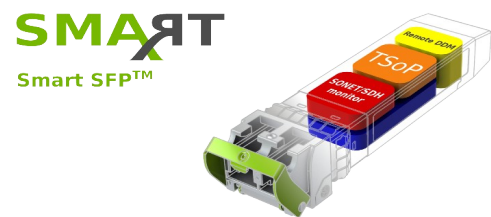
Use cases and dedicated solution scenarios

Each network has unique requirements, depending on various parameters, such as the amount and type of client interfaces to be covered at each site, current and future bandwidth demands, time-to-market, ease of migration, and cost points.

AimValley helps customers with the evaluation of these parameters and provides different implementation solutions.

Let's review some of those solutions:

- A SmartSFP is the optimum fit when only a few legacy client signals are to be provisioned at a small edge location. All that is required is to insert a SmartSFP in the router and allocate a dedicated packet service to the remote location.
- An alternative is to integrate PLE service interfaces on a cost-effective edge router on a few (2 to 4) dedicated multi-rate SFP interfaces. The PLE functions are implemented in a multi-channel FPGA that sits between the SFP ports and the packet switch.
- At large customer sites with multiple high bitrate client signals (for example 100G and above) and different payload types, a slide-in card for the router with 8 to 12 SFP, QSFP or QSFP-DD cages may be a better fit. Such a card would have an FPGA that supports all PLE functionality to convert the multilane signals from client interfaces to packet streams towards the terabit router switch core. AimValley offers turnkey design services that include the development, test and integration of the card, FPGA logic and software functionality to achieve tightly integration solution for our customers.
- Consultancy on network level synchronization design, clock recovery scenarios, ensuring all requirements for high availability and full signal transparency for the client payload signals are met. This includes modeling, prototyping, including evaluation and testing of jitter and wander performance of the overall network.



TSoP SmartSFP for Transparent Network Migration



AimValley Designed 400G card with AMD Versal FPGA



AimValley Designed Hardware card with multiple QSFP ports

Our Proven Track Record!

Our TDM to Packet expertise is successfully deployed in numerous product designs across many customers and equipment. Millions of pseudowires are installed in Telecom networks worldwide using our TDM Smart SFPs and card-based FPGA solutions. These are offered in easy to install plug-and-play configurations, or provided as fully managed and tightly integrated products in our customer's network equipment.

'The TDM Network Migration SFPs greatly reduce system and network complexity, offer lower carbon footprint while generating CAPEX and OPEX savings.'

Our integration and verification test teams use a wide array of test and measurement equipment for TDM protocols, synchronization and jitter/wander performance and packet network impairment generators to ensure compliance with Telecom, synchronization, and packet network standards.

Why AimValley?

AimValley is a reliable provider of TDM and packet switching technology since 2003, delivering solutions for:

- High speed data processing applications
- Complex FPGA-based accelerated systems
- High-speed, low-power hardware equipment
- Robust embedded software
- Early adopter of Acceleration Technology

We excel in building complex systems that are part of your product in the fields of Industry 4.0, Healthcare and Telecom. Our combined skills represent all the important aspects required for the development of end-to-end systems.

Our customers enjoy the benefits of working with a strong team with more than 2 000 years engineering experience. AimValley is a trusted partner of many Tier 1 customers in Telecom and Industrial markets and has shipped more than 100 000 products.

Quality Focus

- High quality, highly reliable solutions and products.
- Outstanding track record of on-time delivery.
- Best in Class Designs – Performance, Time & Budget.
- ISO9001, ISO14001, Ecovadis top 2% CSR Rating.

